# EXHIBIT A

**Helical Anchor Tiebacks:** We recommend that tieback anchors consist of mechanically installed helical anchors. We recommend a minimum 1.5-in square shaft helical anchor with a single 12-inch diameter helix be used for the tieback anchors. We recommend that at least one anchor be treated as performance anchor and be tested to a minimum of 200 percent of the design load to verify capacities. The soil creep characteristics would be evaluated during these tests. The structural engineer should determine the number and layout of the proposed helical anchors. The helical anchors should be installed per manufacture's recommendations. The anchors should terminate behind the no-load zone and should be load tested to confirm load carrying capacities. At a minimum, the anchors advance 10 feet behind the no-load zone.

**No-Load Zone:** The anchor portion of all tiebacks must be located a sufficient distance behind the wall face to develop resistance within a stable soil mass. We recommend the anchorage be obtained behind an assumed no-load zone. The no-load zone is defined by a line extending horizontally from the base of the wall into the slope below the wall a distance of five feet. The line should then extend up from the base elevation at an angle from the horizontal of 60 degrees. We expect competent granular deposits exist beyond the no-load zone. We recommend that we monitor soil conditions during anchor installation in order to evaluate adequate penetration into competent soils.

**Soil Design Values:** The tiebacks will likely terminate in competent granular soils below the residence. Load carrying capacities on the order of 20 kips or more could be achieved using a single- flight, 12-inch diameter helical anchor installed successfully. We recommend, however, that we review anchor design and proposed installation methods. We should also observe anchor installation and testing to verify load carrying capacities.

The anchors should be designed to resist a lateral load resulting from a fluid with a unit weight of 100 pounds per cubic foot (pcf) for active loading conditions in addition to 50 pounds per square foot (psf) uniform surcharge to account for the slab-on-grade. The 50 pcf loading should be increased by 20 percent for the purpose of accounting for temporary seismic conditions. These loads should be applied across the anchor spacing above the excavation line. All lateral loads should be resisted by the helical anchor tiebacks, and no lateral loads should be transferred onto the pin piles.

**Anchor Installation and Testing:** The contractor should be responsible for using equipment suited for the site conditions. The contractor should determine the required installation torque values for the helical

anchors to achieve the desired capacity. However, the anchors should advance a minimum of 10 feet beyond the no-load zone and be tested to confirm design capacities.

A minimum of one anchor should be performance-tested to 200 percent of the anchor design capacity. The performance tests should consist of cyclic loading in increments of 25 percent of the design load, as outlined in the Federal Highways Administration (FHA) report No. FHWA/RD-82/047. Final anchor capacity values will be based on these tests. The test location should be determined in the field, based on soil conditions observed during anchor installation. All production tiebacks should be proof-tested to at least 130 percent of design capacity. The tieback testing program should be reviewed and monitored by NGA.

**Shotcrete Wall Backfill**

After the helical anchors have been completely installed, we recommend that the void area behind the proposed shotcrete wall be replaced with expanded polystyrene (EPS) Geofoam and 2-inch clean crushed rock. All loose soils within this area should be removed and the resulting face be benched to allow installation of the geofoam blocks. Care should be taken to not disturb the helical anchors during geofoam installation. The geofoam blocks should be installed in a manner to minimize void spaces around and in-between the blocks. The front portion of the blocks along the foundation area should be utilized as the back form of the proposed shotcrete wall. After the shotcrete wall has been completed, pressurized grout should be pumped behind the wall and below the residence slab-on-grade to fill the remaining voids within this area. The contractor should determine the most feasible way to install the pressurized grout. If it is deemed that significant void space still exists below the slab, holes should be drilled through the slab to fill the remaining voids.

**Pin Piles**

The new shotcrete retaining wall should be fully supported on the 18, 2-inch diameter driven steel pipe piles that were installed previously as a part of the emergency residence stabilization measures performed within the site. The piles consisted of 2-inch diameter non-galvanized extra strong (Schedule 80) steel pipe sections that driven into place using a hand-held, 140-pound jackhammer. For the 2-inch diameter pipe piles driven to refusal using a hand-held, 140-pound jackhammer, we recommended a design axial compression capacity of three tons for each pile. The piles were driven to a refusal criterion of less than one inch of movement during 60 seconds of continuous driving. The depth of the piles ranged from approximately 43.5 to 56.0 feet below the existing residence foundation. The piles were located in

accordance to the structural engineer's recommendations during the emergency stabilization repairs. Structural brackets were used to connect the pin piles to the existing residence foundation. Piles that had to span more than seven feet from the ground surface to the residence foundation were sleeved with 2.5-inch diameter pipe driven a minimum of eight feet below the ground surface. In our opinion, the pin piles that were previously observed were installed in accordance with the above recommendations and should support the planned loads. The structural engineer should design the connection of the new shotcrete wall connection to the existing pin piles. The loads should be transferred to the 2-inch piles on the inside and bypass the sleeves. We recommend that the above grade portions of the pin piles be fully encased in the shotcrete wall.

Due to the relatively small slenderness ratio of pin piles, maintaining pin pile confinement and lateral support is essential to preventing pile buckling. Vertically driven pin piles do not provide meaningful lateral capacity. All lateral loads should be picked up by the helical anchors. Due to the rigid pile support, friction between the foundation and subgrade soil should not be considered for resisting lateral loads where pin piles are used.

### Erosion Area Stabilization and Drainage

We recommend that the erosion area around and below the residence be cleaned of the loose debris and vegetation, exposing the underlying firm material. The erosion area should be rebuilt, starting at the base of the area where it begins to narrow with a buttress consisting of 2- to 3-man sized quarry rock. The quarry rock buttress should be approximately 8-feet wide by 16-feet long and be keyed a minimum of three feet into the firm native soils. The location of the quarry rock buttress will be determined in the field during construction. The remaining portion of the erosion area behind the quarry rock buttress and around the residence should be backfilled with 4- to 8-inch quarry rock spalls or other material approved by NGA. The rock spalls should be placed in small lifts and tamped in place with a trackhoe bucket or compacted with a vibratory plate compactor. The rock spalls should extend up to the existing ground surface within the vicinity of the erosion area.

The final face inclination of the rock fill should not be steeper than 1.5 Horizontal to 1 Vertical (1.5H:1V). This is extremely important for maintaining future stability of the rock slope. Also, care should be taken as to not contaminate the rock spalls with the native material in order to maintain the rock's free-draining capability. The rock spalls outside areas that may support the future deck and patios could then be covered with topsoil and a heavy duty erosion control matting such as Tensar C350 Turf

Reinforcement Mat, or equivalent, and vegetated with deep-rooting, drought resistant vegetation if desired. The matting should be staked with metal rebar that is either bent at the end or has a metal "T" welded to the end. The mat should be staked to the exposed soil every five feet. A filter fabric such as Mirafi 160N should be placed over the spalls prior to placing the top soil. A cross-section plan titled "Schematic Repair Section Detail" showing the proposed repairs is presented as Figure 4. We should be retained to observe the recommended erosion repairs on a full-time basis.

If deemed necessary, drainage measures within the erosion area could consist of placement of a 4-inch diameter heavy-duty, perforated PVC pipe within a minimum one-foot thick bed of washed rock wrapped in filter fabric at the base of the erosion area. The pipe should be directed to outlet in front of the quarry rock buttress onto a crushed rock pad.

### Deck Support and Patio Repairs

We understand that you wish to reconstruct the deck that was destroyed as a result of the washout. We anticipate that the extents of the deck will likely extend into the newly placed rock spalls within the erosion area. Due to the potential long-term settlement of the rock spalls within this area and difficulty installing deck foundation within the quarry rock, we recommend that the deck be structurally supported on the residence. A walkway area is also proposed around the southern portion of the residence below the deck. We recommend that these areas consist of surfaces that can be maintained such as pavers or flagstone due to the potential of future settlement within this area. The walkway surfaces should be supported on a minimum of 6-inches of 1 ¼-inch crushed rock placed directly on the rock spalls. Specific recommendations regarding the walkway construction can be provided in the field during construction. The design of the deck supports on the residence should be such that sufficient head room is allowed beneath the deck.

If the support of the deck on the residence is deemed unfeasible, it may be possible to support the deck on deep sonotube foundations placed within the rock spalls. The deck sonotube foundations should consist of minimum 18-inch diameter sonotubes placed directly on the rock spalls and extend a minimum of three feet below the finished ground surface of the rock spalls. All lateral loads on the deck supports should be transferred back to the residence foundation via grade beams.

## USE OF THIS LETTER

NGA has prepared this letter for Mr. Peter Norris, and his agents, for use in the planning and design of the slope and residence stabilization project on this site only. The scope of our work does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our letter for consideration in design. No subsurface explorations were performed as part of this study and as such the extent of the anchors and refusal rates are difficult to predict. Our letter, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

We recommend that NGA be retained to review and approve all project plans prior to construction and to monitor repairs. These additional services are intended to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not construction activities comply with specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

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It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

***NELSON GEOTECHNICAL ASSOCIATES, INC.***

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Three Copies Submitted

Four Figures Attached

cc: Greg Guillen- GG Engineering (via email)
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